

## Claims

- [c1] An apparatus for measuring a radius of a hole, comprising:  
a support member having at least one arm, each at least one arm having a first end and a second end, the first end attached to the support member;  
a magnet moveably attached to the support member via the second end of each at least one arm; and  
a first magnetic sensor fixed to the support member for measuring a magnetic field of the magnet.
- [c2] The apparatus of claim 1, wherein the first magnetic sensor is adapted to measure a component of the magnetic field.
- [c3] The apparatus of claim 1, wherein the first magnetic sensor is a magnetoresistive sensor.
- [c4] The apparatus of claim 1, wherein the magnet is a permanent magnet.
- [c5] The apparatus of claim 2, further comprising a second magnetic sensor fixed to the support member.
- [c6] The apparatus of claim 5, wherein the first and second magnetic sensors are spaced apart at a known distance, and the second magnetic sensor adapted to measure the component of the magnetic field measured by the first magnetic sensor.
- [c7] The apparatus of claim 5, wherein the first and second magnetic sensors are at a same location and the second magnetic sensor adapted to measure a magnetic field component that is orthogonal to the component of the magnetic field measured by the first magnetic sensor.
- [c8] The apparatus of claim 3, wherein the first magnetic sensor and the second magnetic sensor comprise magnetoresistive sensors.
- [c9] The apparatus of claim 5, further comprising a third magnetic sensor for measuring an external magnetic field, wherein the third magnetic sensor is spaced apart from the magnet such that the third magnetic sensor is

substantially unaffected by the magnetic field of the magnet in its direction of sensing.

- [c10] The apparatus of claim 9, wherein the third magnetic sensor comprises a magnetoresistive sensor.
- [c11] A downhole tool for measuring a radius of a borehole, comprising:  
a housing having an exterior surface and an interior;  
at least one arm, each of the at least one arm having a first end and a second end, the first end attached to the exterior surface of the housing;  
at least one magnet moveably attached to the exterior surface of the housing and each at least one magnet attached to the second end of each at least one arm; and  
a first magnetic sensor, fixed in the interior of the housing for measuring a magnetic field of the at least one magnet.
- [c12] The downhole tool of claim 11, wherein the first magnetic sensor is adapted to measure a component of the magnetic field.
- [c13] The downhole tool of claim 11, wherein the first magnetic sensor comprises a magnetoresistive sensor.
- [c14] The downhole tool of claim 11, wherein the at least one magnet comprises a permanent magnet.
- [c15] The downhole tool of claim 11, wherein each of the at least one magnet is in a protective enclosure.
- [c16] The downhole tool of claim 11, further comprising a second magnetic sensor, fixed in the interior of the housing for measuring the magnetic field.
- [c17] The downhole tool of claim 16, wherein the first and second magnetic sensors are spaced apart at a known distance and the second magnetic sensor is adapted to measure the component of the magnetic field measured by the first magnetic sensor.
- [c18] The downhole tool of claim 16, wherein the first and second magnetic sensors

are located at a same location and the second magnetic sensor is adapted to measure a magnetic field component that is orthogonal to the component of the magnetic field measured by the first magnetic sensor.

[c19] The downhole tool of claim 16, wherein the second magnetic sensor comprises a magnetoresistive sensor.

[c20] The downhole tool of claim 16, further comprising a third magnetic sensor for measuring an exterior magnetic field, wherein the third magnetic sensor is spaced apart from the magnet such that the third magnetic sensor is substantially unaffected by the magnetic field of the magnet in its direction of sensing.

[c21] The downhole tool of claim 20, wherein the third magnetic sensor comprises a magnetoresistive sensor.

[c22] The downhole tool of claim 16, wherein the downhole tool is one selected from a logging-while-drilling tool, a measurement-while-drilling tool, and a wireline tool.

[c23] A method for measuring a displacement, comprising:  
generating a magnetic field using a magnetic field source;  
measuring a first magnitude of a component of the magnetic field using a sensor disposed within the magnetic field;  
displacing the magnetic field source;  
measuring a second magnitude of the component of the magnetic field using the sensor;  
determining a distance that the magnetic field source is displaced using the first magnitude and the second magnitude.

[c24] The method according to claim 23, wherein the calculating the distance comprises using a function of magnitudes of the component of the magnetic field with respect to distances between the sensor and the magnetic field source.